CEMENT BASED LAMINATED ARMOR PANELS

CROSS REFERENCE TO RELATED APPLICATIONS

This application claims the benefit of U.S. Provisional Application No. 61/033,264 filed Mar. 3, 2008 incorporated herein by reference and is related to:

U.S. Provisional Patent Application No. 61/033,240, entitled PROCESS FOR MANUFACTURING CEMENT BASED ARMOR PANELS, filed Mar. 3, 2008;

U.S. Provisional Patent Application No. 61/033,258, entitled CEMENT BASED ARMOR PANEL SYSTEM, filed Mar. 3, 2008;

U.S. Provisional Patent Application No. 61/033,212, entitled A SELF-LEVELING CEMENTITIOUS COMPOSITION WITH CONTROLLED RATE OF STRENGTH DEVELOPMENT AND ULTRA-HIGH COMPRESSIVE STRENGTH UPON HARDENING AND ARTICLES MADE FROM SAME, Mar. 3, 2008;

U.S. Patent Application No. 61/033,061, entitled TRANSPORTABLE MODULAR SYSTEM OF COMPONENTS FOR PHYSICAL PROTECTION, filed Mar. 3, 2008; and

U.S. Patent Application No. 61/033,059, entitled TRANSPORTABLE MODULAR FRAME FOR HOLDING PANELS FOR PHYSICAL PROTECTION, filed Mar. 3, 2008;

all herein incorporated by reference in their entirety.

STATEMENT OF FEDERALLY SPONSORED RESEARCH

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FIELD OF THE INVENTION

This invention relates generally to an improved high-performance cement based armor panel with exceptional resistance to ballistic and blast loads having a unique fiber reinforced cementitious core composition with controlled strength development and a high performance skin-reinforcement attached to at least one surface of the cementitious core panel.

The cementitious core is made from an inorganic cementitious binder, typically hydraulic cement such as portland cement; an inorganic mineral filler, preferably silica sand of 150-450 micron median particle size and 0.80-1.50:1 weight ratio to the cementitious binder; a pozzolanic micro filler, preferably silica fume of average particle size of about 0.1 micron; about 0.75-2.5% by weight of the total composition of an organic based self-leveling chemical agent, based upon polycarboxylated chemistry, preferably polycarboxylated polyether (Superplasticizer), optional alkanolamine and acid or acid salt fluidity additives, fibers and water.

The mixture for forming the cementitious core is self leveling when mixed and develops significant strength after hardening. The cementitious core does not include silica flour, which has been found to produce a cementitious core composition which is too thick in consistency to be formed into a usable panel core with conventional production equipment.

The cementitious core composition is used in combination with a fiber reinforced skin material used to laminate at least one surface of the cementitious core of the panel. A variety of skins can be used to laminate the core of the cementitious armor panel. However, fiber reinforced polymer (FRP) laminates as skins are preferred. Fiberglass reinforced resin is the especially preferred FRP. The skin (S) is placed on the core (C) as a laminate of SC or SCS or SCSCS structural design.

Panels made with the improved cement composition have sufficient strength to resist blasts and ballistic impacts without or without steel fibers or steel reinforcement.

BACKGROUND OF THE INVENTION

Fiber reinforced cementitious compositions containing hydraulic cement, inorganic mineral fillers and pozzolans as well as chemical additives like plasticizers and water dispersants have been used in the construction industry to form the interior and exterior walls of residential and/or commercial structures. However, a drawback of such conventional panels is that they do not have sufficient compressive strength to provide a high degree of resistance to ballistic and blast loads.

Current practice for producing ultra-high strength cementitious compositions relies upon efficient particle packing and extremely low water dosage for achieving ultra-high material strength. As a consequence of the raw materials utilized to achieve dense particle packing and the extremely low water usage in these compositions, the cementitious mixtures have extremely stiff rheological behavior with dough like consistency in the freshly mixed state. The stiff consistency makes these mixtures highly unworkable and extremely difficult to process in conventional manufacturing processes for making thin cement-based products and composites.

U.S. Pat. No. 4,158,082 A to Belousofsky discloses a laminated cement based structure with a fiber glass skin that is impact resistant and may use Portland based cements.

U.S. Pat. No. 4,793,892 to Miller discloses an apparatus for manufacturing a concrete panel with cement core and fiber glass facing utilizing Portland cement.

U.S. Pat. No. 4,948,429 A to Arfaei discloses a cementitious composition containing portland cement, sand, fumed silica and a polyether.

U.S. Pat. No. 5,724,783 to Mandish disclose a building panel and assembly system composed of Portland cement panel layers attached to a panel framework with multiple layers.

U.S. Pat. No. 6,119,422 B1 to Clear discloses an impact resistant strong structural cementitious building panel with outer facing of fiberglass reinforcing mesh where the composite cementitious has an aggregate core with inner and outer faces of fiberglass mesh.

U.S. Pat. No. 6,176,920 to Murphy disclose a method of method for constructing a cementitious panel of multiple layers utilizing a smoothing head, shearer and screeding process.

U.S. Pat. No. 6,309,457 B1 Guerinet et al. discloses a self-leveling cement composition that includes Portland cement, silica sand of maximum 10 mm size or 0-5 mm size, or a blend of 0-0.4 mm and 0-5 mm size; fine mineral aggregates such as fly ash or silica flour having dimensions of less than 200 microns, preferably less than 100 microns; a first plasticizer which is a water-soluble or water-dispersible organic compound containing at least one aminodi(alkenephosphonic) group; and a second water-soluble or water-dispersible plasticizer which is of the polycarboxylic acid type and contains polyether chains. Example 1 indicates a compressive strength in 28 days of 32 MPa (about 4600 psi).